

CENTROSOMES DURING EARLY FERTILIZATION STAGES IN PREISSIA QUADRATA

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(WITH PLATE 8)

The problem as to the behavior of the centrosome during cell and nuclear fusion cannot be said to be settled for either plant or animal cells and from this standpoint I am engaged in an investigation of the processes connected with fertilization in *Preissia quadrata* (Scop.) Nees.

My material was collected from gorges around Ithaca and prepared for sectioning at Cornell University. I am indebted to Professor G. F. Atkinson for the privileges of the botanical laboratory there, where for several years I experimented with methods of handling the plants and with various killing reagents. I also acknowledge the privileges of the laboratory in the Cornell Medical College at Ithaca. The material was killed in the field in a modified Flemming solution. The sections were stained and studied at the botanical laboratory at Columbia University and were examined by Professor R. A. Harper, to whom I am indebted for a critical examination of my stained preparations.

Dr. Osvaldo Kruch ('90) observed many eggs of *Riella Clavsonis* with one antherozoid in the cytoplasm. He also observed that both nuclei before fusion were approximately of the same size. Fusion of the pronuclei was not observed, nor were astral rays and centrosomes. Since this article by Kruch no other has appeared on fertilization in the liverworts.

I shall describe here only the stages after the egg has been penetrated by the antherozoid and when the pronuclei are already near together. During this stage the cytoplasm of the egg of *Preissia quadrata* is plainly made up of two zones. The inner zone is granular with rounded bodies forming a dense aggregate that lies in masses around the pronuclei and among the rays of the

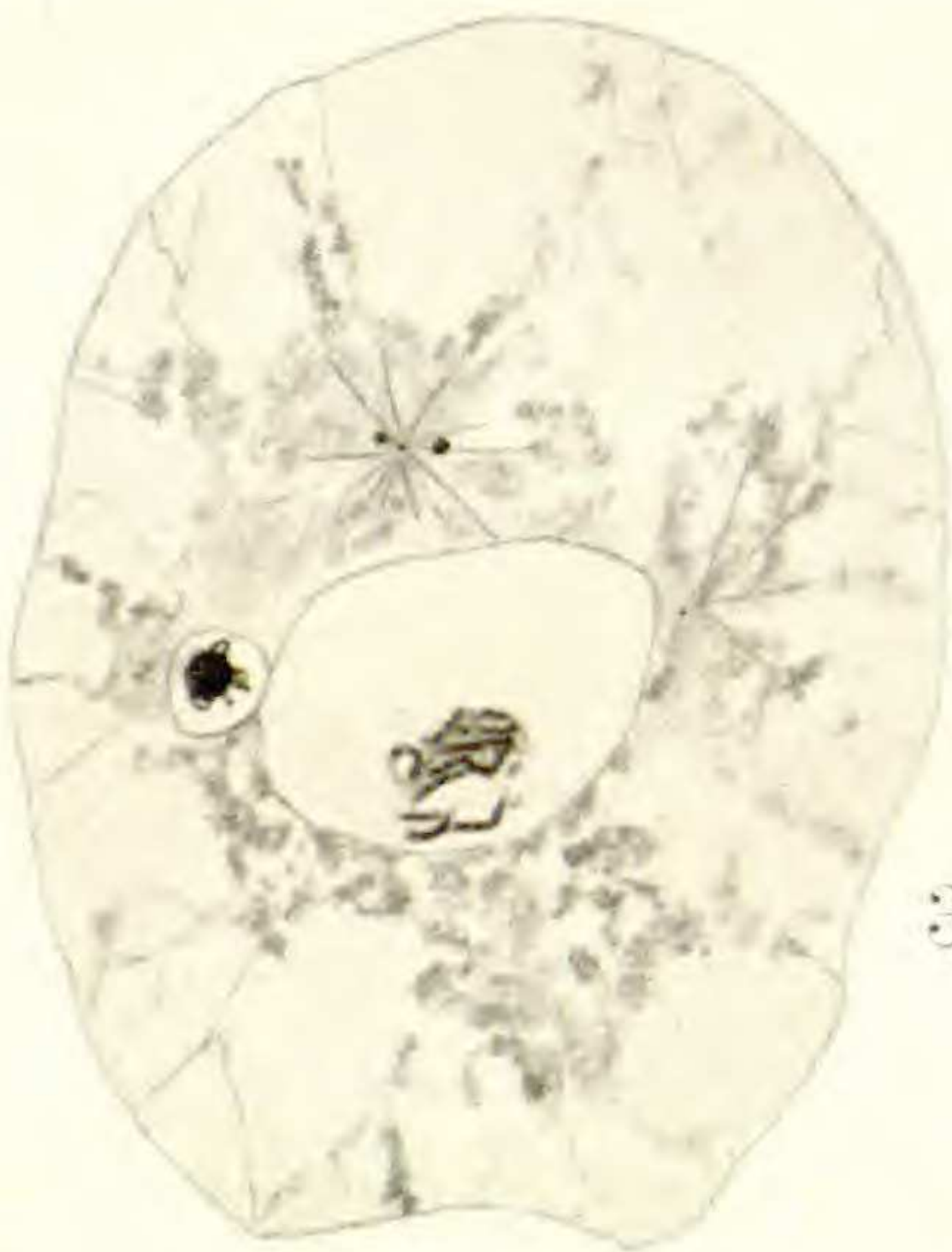
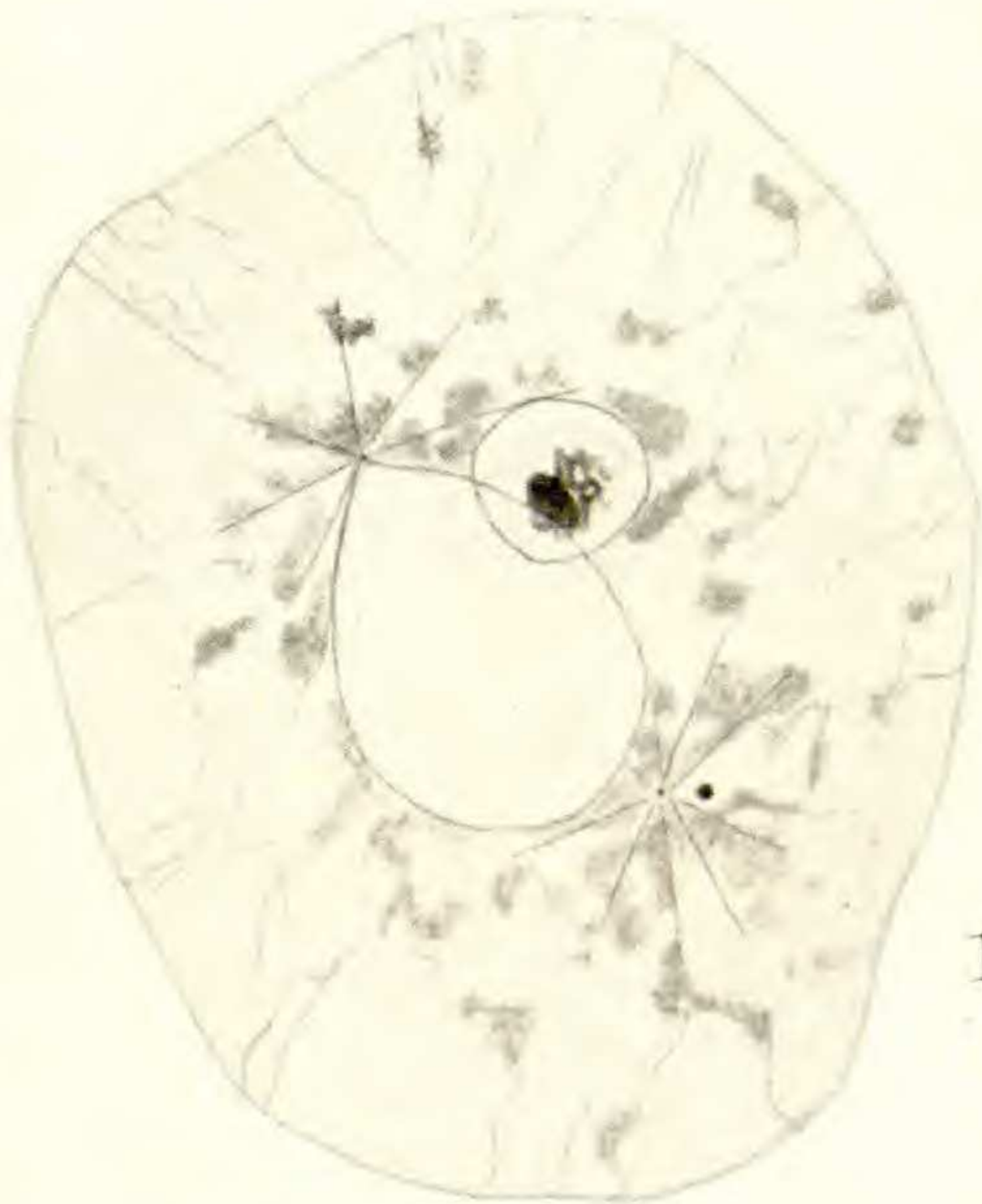
centrospheres. A small amount of the same material also clings to the cytoplasmic fibers at the periphery of the cell. This dense cytoplasm may appear more or less alveolar at this stage. Prior to fertilization the whole cytoplasm of the egg has this consistency. The outer zone of the cytoplasm is coarsely vacuolar. The films between the vacuoles are very thin and delicate. A few larger and quite dense homogeneous granules are scattered through both zones of the cytoplasm. The egg nucleus and the nucleus of the antherozoid are plainly differentiated by their size and in FIGURES 1, 2, and 3 are shown lying in the central part of the cell. In FIGURES 1 and 3 their nuclear membranes are in contact.

In the dense cytoplasm at the opposite poles of the egg nucleus astral rays are seen converging upon small dense rounded bodies, the centrosomes (FIGS. 1 and 2). These rays extend long distances through the cytoplasmic ground substance. They may pass close to the nuclear membrane or may touch it. A fiber radiating from the centrosome at the upper part of FIGURE 1 touches the nuclear membrane of the antherozoid; another radiating from the same centrosome touches the outer membrane of the egg nucleus. The astral rays make up an open aster with few rays; but they are very definite fibers easily distinguishable from other cytoplasmic structures. Peripherally they end rather abruptly and have no conspicuous physical connection with any of the other elements of the dense cytoplasm. It is quite possible that there are other shorter and more delicate rays, but I have drawn only those which are plainly differentiated. All these fibers center on a centrosome which seems to be a single body.

FIGURE 3 shows a slightly earlier stage of fertilization. A centrosphere lies above the egg nucleus, the rays extending to its membrane. FIGURE 4 is another section of the same egg and shows a second centrosphere.

One or more large dense bodies lie among the astral rays a short distance from the center, but they do not constitute a part of the region on which the rays center (FIGURES 1-4).

Centrosomes and asters have been demonstrated in the vegetative cells of liverworts by Farmer and Reeves ('94) in the germinating spore of *Pellia epiphylla* and by Van Hook ('00) in the cells of the stalk of the archegoniophore of *Marchantia polymorpha*.



GRAHAM: CENTROSOMES IN PREISSIA